PATENT SPECIFICATION

DRAWINGS ATTACHED

960,102

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COMPLETE SPECIFICATION

Improvements in and relating to Apparatus for Electrostatically Spray Coating

We, RANSBURG ELECTRO-COATING CORP. a corporation incorporated under the laws of Indiana, United States of America, of 3939 West 56th Street, Indianapolis, Indiana, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the spray coating of articles and more particularly to an electrostatic spray coating system. It is the general object of this invention to produce new and improved spray coating apparatus and methods.

In the specification of copending application No. 30818/60 (Serial No. 865,765) there are described forms of electrostatic spray coating apparatus in which means are adopted whereby the danger of electric shock or fire hazard, due to spark ignition of an inflammable paint solvent vapour, can be avoided.

The present invention also concerns an electrostatic spray coating apparatus having improved safety in these respects, and the invention includes apparatus for electrostatically coating an article with liquid coating material, comprising an atomising device with an exposed charging electrode at its forward end, an electrical circuit for impressing a high voltage on said electrode, said electrical circuit being so responsive to changes in the length of the air gap between said electrode and the nearest earthed object as to appreciably reduce the potential difference between said electrode and the earthed object as the air gap between them decreases, means for feeding liquid coating material to said device for atomisation therefrom and charging by said electrode, and a shield of insulating material surrounding said charging electrode and projecting forwardly thereof a distance greater than the sparking distance of said electrode to the nearest earthed object, but substantially less than would be the sparking distance of said electrode with a similar voltage applied by an electrical circuit which is substantially unresponsive to changes of air gap.

The invention also includes apparatus for electrostatically coating an article with liquid coating material, comprising an atomising device with an exposed charging electrode at its forward end, an electrical circuit including a voltage source for impressing a high voltage on said electrode, said electrical circuit being so responsive to changes in the length of the air gap between said electrode and the nearest earthed object as to appreciably reduce the potential difference between said electrode and the earthed object as the air gap between them decreases, means for feeding liquid coating material to said device for atomisation therefrom and charging by said electrode, and a shield of insulating material surrounding said charging electrode and projecting forwardly thereof a distance greater than the sparking distance of said electrode to the nearest earthed object, but substantially less than would be the sparking distance of said electrode with a similar voltage applied by an electrical circuit which is substantially unresponsive to changes of air gap.

A voltage supply circuit which, for the purposes of this specification can be considered to be substantially unresponsive to changes in length of the air gap between the charging electrode and the nearest earthed article is described in specification 865,765, and has a characteristic in the working range such as that which is shown in curve 59*a* of Figure 4 of the drawings accompanying that specification.

Other features and advantages of the invention will appear from the following description of an embodiment thereof, given by

[*Price 4s. 6d.*]

way of example, in conjunction with the accompanying drawings in which:—

Figure 1 is a diagram of the arrangement of a hand gun, and

Figure 2 is a fragmentary longitudinal section of the atomising and charging head of a hand gun.

The hand held gun which is shown schematically in Figure 1 comprises an elongated body portion 75 of insulating material provided with a metal grip portion 76 and trigger means 77 for operating a valve which controls the flow of liquid coating material. An annular atomising member 78 is rotatably mounted at the forward end of the body 75. This annular atomising member is preferably of insulating material coated with a layer of material of high electrical resistivity. This rotating atomising device is charged to a high voltage, for example 80 or 90 kilovolts, through a circuit having a high effective impedance, in this case provided by resistors 79 and 80 of the order of 500 megohms each. The resistors are supplied with high voltage from a power supply 81 adapted to provide an output voltage of the order of 100 kilovolts, for example, in use, so that high voltage will be established on the edge of the head through the circuit including the resistors and the resistance layer on the head itself. Within the rotating atomising member 78 is an inner electrode 82 of insulating material also coated with a material that presents a high but finite resistance; in operation, this is maintained at a voltage intermediate that of the atomising device and earth by leakage current passing from the annular atomising member 78 to this inner electrode 82 and then through a voltage dropping resistor 83, which may have, for example, a value of the order of 10,000 megohms. A connection to earth from the resistor 83 is completed through the electric motor 84 which rotates the rotatable parts at the forward end of the device, the motor being earthed through the earthed metal grip 76. The advantages of an arrangement of this kind will appear more clearly from the prior specification referred to above, to which attention is directed.

With the present construction, the rotating annular atomising member 78 has associated with it a very light and compact shield here identified as 85, and this shield and its relation to the other parts will now be more fully described.

Referring now more particularly to Figure 2, it will be seen that the rotating atomising member 78 is tapered on its inner surface to a relatively sharp outer edge 78*a*. Liquid coating material supplied through the feed tube 86 flows in a thin film on the inner surface of the rotating member to the edge 78*a* where it is electrostatically atomised. The high potential atomising and charging field at this edge is created in part by the voltage differential between this edge and the earthed article being coated, and in part by the potential drop between this edge and the edge 82*a* of the inner counter-electrode. Potential is delivered to the highly resistive (but slightly conductive) coating on the outer surface of the atomising member 78 by a small metal finger or brush 87 which makes contact with this conductive film during rotation of the member.

The electrical function of the parts described above will appear from a consideration of Specification 865,765. At normal air gap spacings, for example about 8 inches, between the atomising edge 78*a*, which in this case is also the charging electrode, and the nearest earthed article or other object, these circuits are designed to maintain a specified potential, for example of the order of 80 kilovolts at the atomising edge, but a decrease in the air gap results in a reduction of the potential at the atomising edge, to the extent that any sparking or other electrical discharge from the atomiser can be brought to an order of only one half inch in length, and so weak as to be incapable of causing discomfort to personnel, or any fire, if an inflammable paint solvent is used. Electrical circuits so designed are quite different from those conventionally used in electrostatic coating systems which are substantially devoid of any potential-reducing characteristics; such conventional circuits merely involve the connection of the atomising device to the high voltage terminal of a well-regulated power pack to maintain the atomising device at a substantially constant voltage at all distance beyond sparking distance, for example 4 or 5 inches.

The shield contemplated by this invention surrounds the atomising and charging edge 78*a* and extends forwardly thereof a small distance which is greater than the sparking distance between the atomising edge and the nearest earthed object, but substantially less forwardly than would be the sparking distance of an electrode at a similar voltage but supplied by an electrical circuit which is substantially devoid of potential reducing characteristics, such as a conventional transformer and vacuum rectifier circuit, and may be with a series resistance, such as 10 megohms, which at the small currents concerned causes only a small voltage drop at the output.

The combination with the potential-reducing circuit enables the satisfactory use of a much shorter shield than would otherwise be possible, providing a gun which is much handier in use.

The shield 85 is here shown as carried by and rotating with the annular atomising member 78, preferably being a push-fit thereon. It is made of good high-voltage insulating material, preferably flexible, for example polyethylene. The forward portion 85*a* of the shield may be relatively close to the atomis-

ing edge, and need project but little forwardly of the edge. It is our belief that the presence of the inner counter-electrode provided by the member 82 permits the shield to be brought very close to the atomising edge without detracting from the quality of the electrostatic atomisation; but whatever the reason may be, we find that in the type of hand held atomising device here illustrated, the shield can be within half an inch of the atomising edge. The shield here shown still exerts a very desirable compressing effect on the exterior diameter of the pattern, and minimises the thin fringe of somewhat drier spray particles which would otherwise surround the desirable portion of the spray pattern, without in any way detracting from the quality of atomisation.

Moreover, we have found that by providing the shield with an inwardly extending back portion here identified as 85*b*, leakage currents from the metal finger or brush 87 are greatly reduced, and it as well as the atomising edge are shielded from accidental undesired contacts. In a high impedance hand held atomising device of the kind here described, we find that the presence of this shield portion around the metal connector finger or brush 87 results in as much as 5 KV higher atomising voltage at the atomising edge 78*a*. It will thus be seen that the shield 85, particularly in combination with an atomising and charging device of the general character described, and illustrated, provides good mechanical protection, desirable reduction in external diameter of the pattern without reducing the quality of the electrostatic atomisation, and shields the brush connection in a manner improving transfer of voltage to the atomising edge.

While we have shown and described certain embodiments of the invention, it is to be understood that it is capable of many modifications.

WHAT WE CLAIM IS:—

1. Apparatus for electrostatically coating an article with liquid coating material, comprising an atomising device with an exposed charging electrode at its forward end, an electrical circuit for impressing a high voltage on said electrode, said electrical circuit being so responsive to changes in the length of the air gap between said electrode and the nearest earthed object as to appreciably reduce the potential difference between said electrode and the earthed object as the air gap between them decreases, means for feeding liquid coating material to said device for atomisation therefrom and charging by said electrode, and a shield of insulating material surrounding said charging electrode and projecting forwardly thereof a distance greater than the sparking distance of said electrode to the nearest earthed object, but substantially less than would be the sparking distance of said electrode with a similar voltage applied by an electrical circuit which is substantially unresponsive to changes of air gap.

2. Apparatus for electrostatically coating an article with liquid coating material, comprising an atomising device with an exposed charging electrode at its forward end, an electrical circuit including a voltage source for impressing a high voltage on said electrode, said electrical circuit being so responsive to changes in the length of the air gap between said electrode and the nearest earthed object as to appreciably reduce the potential difference between said electrode and the earthed object as the air gap between them decreases, means for feeding liquid coating material to said device for atomisation therefrom and charging by said electrode, and a shield of insulating material surrounding said charging electrode and projecting forwardly thereof a distance greater than the sparking distance of said electrode to the nearest earthed object, but substantially less than would be the sparking distance of said electrode with a similar voltage applied by an electrical circuit which is substantially unresponsive to changes of air gap.

3. An apparatus in accordance with claim 1 and comprising an atomising and charging gun adapted to be connected to a high voltage supply for establishing an appropriate working voltage on said charging electrode, said gun including a current path, forming part of said electrical circuit, between a point for connection to said supply and the charging electrode, said path including means to ensure the desired potential reduction of said electrode when the gun is connected to a supply the voltage output of which, of itself would be substantially unresponsive to changes of air gap.

4. Apparatus in accordance with any of the preceding claims, wherein the charging electrode is a rotating atomising head.

5. Apparatus in accordance with claim 4, wherein the rotating head is constructed of insulating material having on one of its surfaces a layer of material which presents a high electrical resistance in said electrical circuit.

6. An apparatus in accordance with claims 4 or 5, wherein said atomising head has a substantially circular edge from which coating material is atomised and charged.

7. An apparatus in accordance with claim 6, wherein said head includes a counter electrode disposed radially within said circular edge.

8. Apparatus in accordance with any of claims 4 to 7, wherein said shield is mounted on and rotates with said rotating head.

9. Apparatus in accordance with any of claims 4 to 8, wherein said electrical circuit includes a stationary conductor in rubbing

contact with an outside surface of said rotating head and said shield extends over said conductor at the point of contact.

10. Apparatus in accordance with any of claims 4 to 9, wherein said shield encloses the entire outer surface of said rotating head.

11. An improved electrostatic coating apparatus substantially as described herein with reference to the accompanying drawings.

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960,102 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale.*

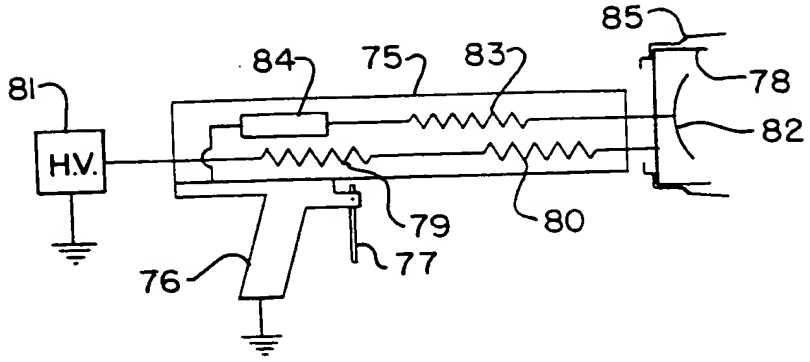

Fig. 1

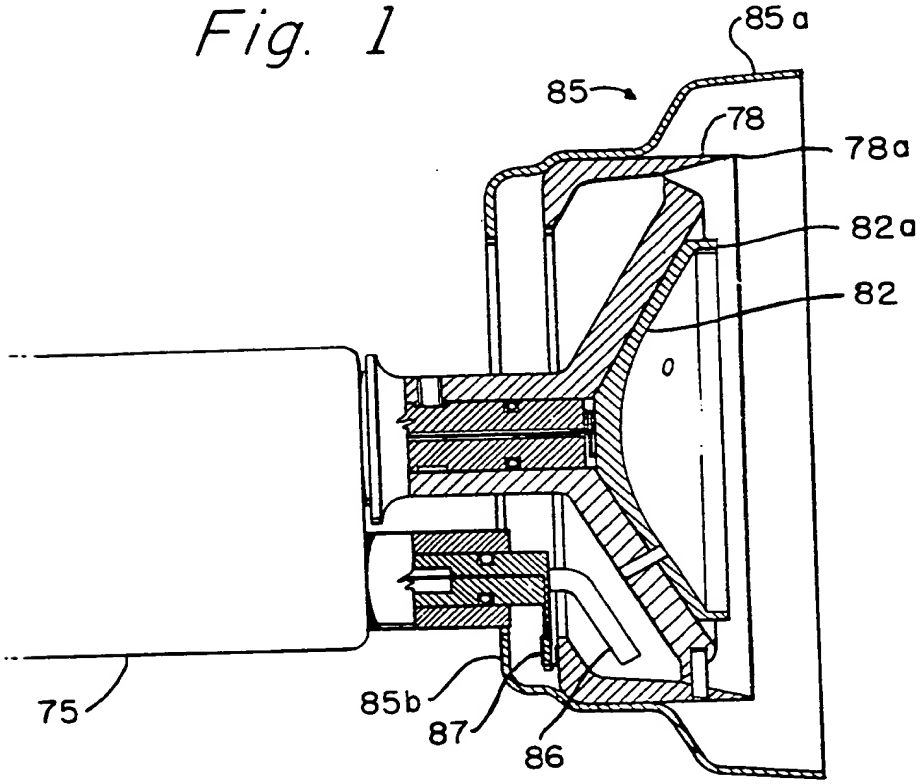

Fig. 2